EDITORIAL

BRAVE partners gathered on October 16 and 17 in Linköping (Sweden) for the third General Assembly. The main goal of this meeting was to share the project results and coordinate the tasks between all work packages for the coming months.

Some of our most important work (both done and planned) is detailed in this newsletter: our driver monitoring concept, the investigations regarding the expectations and concerns about automated vehicles (including insights from the users focus groups and set up of the population survey) and the testing of VRUs detection HMI using VTI's moving-base simulator.

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Driver monitoring

For the task of Driver monitoring, we had to tackle several partial problems. The first task was to detect the driver's face. For that purpose we took two different approaches. One of them based on a Histogram of Oriented Gradients + Support Vector Machine (HOG+SVM) and the other one based on the Single Shot Detector (SSD) using a ResNet base network. Making a comparation between the two methods, the first one turned out to be a bit more stable but the second one is much faster. Hence, we decided to implement the second option.

Once we had the face detected, we made use of the pre-trained facial landmark detector inside the dlib library to estimate the location of 68 (x,y)-coordinates that map to facial structures on the face. This facial landmark detector is an implementation of the One Millisecond Face Alignment with an Ensemble of Regression Trees paper by Kazemi and Sullivan.

Implementation of the One Millisecond Face Alignment with an Ensemble of Regression Trees paper by Kazemi and Sullivan

With this set of points we can extract the position of the eyes in each frame. As we can observe in the image above, there are 6 points per eye, delimiting the eyelids. Using the distances between these points (horizontal and vertical distance) we can then calculate the Eye Aspect Ratio (EAR), with which we can detect when the eye is closed or open, hence we can easily calculate the blink frequency, PERCLOS (percentage of eye closure), amplitude of the eye opening, etc.

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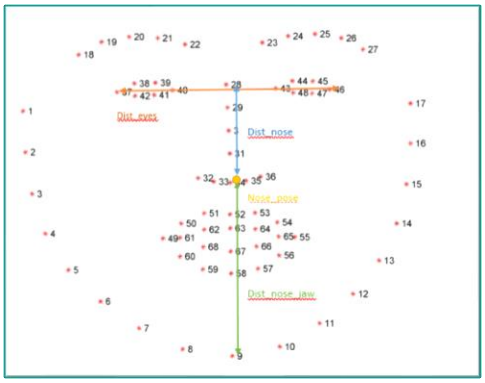
On the other hand, using the set of points delimiting the lips, we know when the driver is yawning. Furthermore, we can measure the initial face structure in order to follow the head position.

The last task to address would be the gaze estimation. For this task we need to take a different approach, since we cannot detect the pupils with the previous tools. As we saw, we can only estimate roughly the gaze direction making use of the facial structure, obtaining nine sectors in the frame. But the driver may have the head fixed and be looking to a different position.

Hence, the proposed method is to make use of a CNN, which is the task in which we are currently working, in order to get a more accurate gaze estimation.



Measure of the initial face structure to follow the head position.

Investigations into expectations and concerns about automated vehicles

The introduction of automated vehicles (AVs) on public roads will only be successful if requirements and expectations for this new technology are met and concerns about it are taken seriously. BRAVE has therefore set itself the task to shed light on the acceptance of AVs of all road users. Until now, the major part of research on opinions about and acceptance of AVs is focusing on the potential users – acceptance measured by the willingness to purchase and/or use such a vehicle. The view of the other road users who are directly affected and interact with an AV in road traffic (as the so called vulnerable road users (VRUs): pedestrians, cyclists and motorcycle drivers) has so far received little consideration.

In order to learn more about possible concerns and expectations of automated cars, a representative survey will be conducted in five European countries and in the USA and Australia in autumn/winter 2019. To prepare this survey, focus group discussions were held in four European countries (Germany, Slovenia, Spain and Sweden) in spring 2018. In the following, the results of the focus group discussion and the aim of the population survey are presented briefly.

RESULTS OF THE FOCUS GROUP DISCUSSIONS

In thirteen focus groups, some of these differentiated by age and gender, 96 road users discussed expectations and concerns about the introduction of automated vehicles. It turned out that most of the respondents were in principle positive about the introduction of AVs. Nevertheless, concerns regarding road safety have also been expressed. The spectrum from positive expectations to (negative) concerns ranged from: A car in an automated driving mode will adhere more strongly to the traffic rules than human drivers and will be permanently vigilant as the technology cannot be inattentive or distracted, to: the technology may not work reliably and the driving programs may not be able to cope with every traffic situation, i.e. they may not accurately detect or predict the intentions of cyclists or pedestrians.

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Due to the focus group discussions, it is not possible to make any statements about how widespread certain expectations or concerns are among the population. One can primarily learn from it the range of possible assessments.

POPULATION SURVEY OF ROAD USERS

With the data from the population survey the preexisting results from the explorative research can be further elaborated and statistically sound results will be gained. The survey aims to depict the acceptance as well as expectations and concerns about automated vehicles at SAE Level 3 by different road user groups (with focus on VRUs). The research hypothesis are:

- The acceptance of automated cars at SAE Level 3 differs between road user groups under control of age, gender and other factors,
- The acceptance of automated cars at SAE Level 3 of VRUs is lower than that of other road users (car drivers),
- The general acceptance of automated vehicles at SAE Level 3 varies according to country and region under control of age, gender and other factors,
- Road user groups have different considerations and expectations towards automated cars on SAE Level 3.

In all seven countries of the participating project partners of BRAVE (France, Germany, Spain, Slovenia, Sweden, plus the USA and Australia) a web survey will be employed. Online access panels will be used to recruit 1000+ respondents per country. Respondents must be at least 18 years old and a “road user” – so practically including every adult citizen. The survey will last 15 to 20 minutes and includes questions about the current mobility and participation in road traffic of the respondent, acceptance, trust, concerns, and expectations regarding automated vehicles at SAE Level 3, ethical implications, how the automated vehicles should interact with VRUs, and socio-economic status of the respondent.

Compared to most previous surveys on the acceptance of AVs, this survey has the advantage that it does not only focus on car drivers but addresses all road users. Moreover, most previous studies rarely exploit a systematic approach and hardly enable comparisons between different road user groups. The results of the BRAVE population survey will provide technicians and other stakeholders with information that can be considered in the further development of AVs.

VRUs detection HMI to increase trust in SAE Level 3 automated driving

Implementing automated driving features in vehicles (SAE Level 3) in urban areas is a challenge due to the constant and often unpredictable interaction between vehicles and vulnerable road users (VRUs). To tackle this problem, in BRAVE we have designed an HMI feature that keeps the driver constantly informed about the presence of VRUs in the nearby environment. This way, the driver has enough time to disengage from other tasks (e.g. watching a video) and co-monitor with the system until it is safe again to resume the task.

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This system has recently been tested in a moving-base simulator at VTI Gothenburg office. Participants with and without prior experience with driver support features (SAE Level 2) drove in an urban environment while watching a video on a tablet. The level of information about VRUs around varied across four conditions: a) no information, b) a take-over warning when the collision was imminent, c) a pre-warning message informing about the presence of VRUs nearby and, d) warning and pre-warning features together. The results showed that an HMI strategy integrating pre-warning and warning messages is the best solution to increase safety while also enhancing driver trust in the overall system. However, results also showed that prior experience with automated vehicles is necessary for this to occur.

These results support the design of HMI for automated driving features based on the needs, preferences and capabilities of users to ensure higher levels of acceptance and safety

BRAVE partner UTAC attended Stuttgart AD

Leader of the project's Work Package 6, which aims to make proposals for regulation & Euro NCAP autonomous driving requirements and assessments, Alain PIPERNO from UTAC made a presentation at Stuttgart Autonomous Vehicle interior design and technology symposium in Stuttgart the 22nd May 2019, and proposed a large review of the work in progress for HMI and driver monitoring for ADAS & AD in regulation groups, Euro NCAP groups and BRAVE Work Packages.

Alain PIPERNO (UTAC) presentation at Stuttgart symposium

KEY FIGURES

Consortium: 10 partners from 7 countries (Spain, France, Germany, Slovenia, Sweden, U.S.A, Australia)

Project duration: 36 months

7 **work packages**

27 experts involved in the **Advisory Board**

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